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# BULLETIN

OF THE

## AMERICAN PHYSICAL SOCIETY

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PROGRAM OF THE

## PULLMAN, WASHINGTON MEETING

STATE COLLEGE OF WASHINGTON

JUNE 17-18, 1932

IN AFFILIATION WITH

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION
FOR THE ADVANCEMENT OF SCIENCE

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## PULLMAN, WASHINGTON MEETING, JUNE 17–18, 1932

IN AFFILIATION WITH

## THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE

The 178th regular meeting of the American Physical Society will be held at the Washington State College, Pullman, Washington, Room 110 Mechanical Arts Building, in affiliation with the Astronomical Society of the Pacific and the Pacific Division of the American Association for the Advancement of Science, June 17 and 18, 1932.

Titles and abstracts of the papers to be presented are given in the following pages. These abstracts have not been corrected by the authors. After correction, they will be published in an early number of the Physical Review. Authors should send corrections to the Editorial Secretary, American Institute of Physics, 11 East 38th Street, New York, New York.

There will be three sessions of the Society, the first one being on Friday morning, June 17, at 9:30 a.m. in the Mechanical Arts Building, Room 110; the second being a joint session with the Astronomical Society of the Pacific, beginning at 2:00 p.m. on Friday June 17 in the Mechanical Arts Building, Room 110. The third session will occur at 9:30 a.m. of Saturday June 18 in the Mechanical Arts Building, Room 110. The program on Saturday morning will include such supplementary papers as remain after the two regular sessions.

*Dinner.* On Friday evening, June 17, there will be an informal dinner for members of the Physical Society and the members of the Astronomical Society of the Pacific who care to attend. Arrangements to be announced later.

*Luncheon.* On Friday and on Saturday members of the Physical Society will lunch together. Detailed arrangements to be announced later.

All members of the Physical Society are requested to register on arrival at the registration desk, Home Economics Building, Room 104.

Other meetings for the current season are as follows:

179. June 23–25, 1932. New Haven.
180. November 25–26, 1932. Chicago.
181. December 16–17, 1932. Pacific Coast. Pasadena.
182. December 28–30, 1932. Atlantic City. Annual Meeting.

LEONARD B. LOEB
Secretary for the Pacific Coast
University of California, Berkeley, Calif.

## FRIDAY MORNING 9:30 O'CLOCK

### Hall, Room

**1. The energy distribution of electrons in field current emission.** Jos. E. Henderson, R. K. Dahlstrom, Frank R. Abbot. *University of Washington.*—The energy distribution of electrons extracted from a cold tungsten filament by means of a high electrical field was obtained by using an arrangement of three cylinders with the filament as the common axis. The two inner cylinders were grids. The potential which produced the field necessary for emission also accelerated the electrons through the first grid. By connecting the second grid directly to the filament except for a small variable accelerating potential these electrons were then decelerated. With various magnitudes of field currents the current to the second grid was measured as a function of this small accelerating potential. From these data the energy distribution of the electrons was obtained. The most striking feature of the distribution was that the largest number of electrons had energies only slightly below the maximum. The relative numbers having lower energies increases with the magnitude of the field currents. The range of energies extended over approximately thirty volts. The outer cylinder provided a means of determining the effect of secondary electrons, which effect was found to be small.

**2. Mobilities of sodium ions in helium measured in short time intervals.** Leonard B. Loeb. *University of California.*—Extending the mobility measurements of sodium ions in various gases (Phys. Rev. **38**, 549, 1931), as a function of time to helium using an improved oscillator designed for the writer by the Bell Telephone Laboratories and using a new baked-out glass chamber, the following results were obtained. In intervals of $2\times10^{-5}$ sec. and $5\times10^{-4}$ sec., the sodium ion has the astonishingly high mobility of about 30 cm/sec. per volt/cm. Below $5\times10^{-4}$ sec., the mobility has a value of about 23 cm/sec. In the old metal chamber with a directly heated Kunsman source, rather uncertain values indicated the presence of ions of mobilities 30 cm/sec., 23 cm/sec., 17 cm/sec., and 13 cm/sec. on progressive aging. The latter values are somewhat in doubt and the more exact values in the new chamber are open to an uncertainty of the order of magnitude of 5 percent owing to the inadequate knowledge of the temperature correction to be applied in the new chamber.

**3. Electroscope of high charge sensitivity.** E. J. Workman, *National Research Fellow* and H. B. DeVore, *California Institute of Technology.*—Electroscopes for use in ionization measurements have been developed to combine a high voltage sensitivity over a limited range with a very small capacity. Bearing in mind that the character of the voltage calibration curve is determined by the rate of variation of capacity with deflection, instruments have been designed to have this vary abruptly in the voltage range in which it is desirable to work. This modification of the calibration curve has been achieved by electrically shielding the deflecting element by placing it in a small metal trough or slot. The size, shape, and position of the trough can be adjusted to give the desired sensitivity at the collecting voltage required. This principle has been applied to the deflecting fibre type in which a heavy quartz fibre, fixed at one end, is used, and to the torsion types where the deflecting element consists of a short quartz fibre fixed at the center to the torsion member. A deflecting instrument has been used which gave a full scale deflection of 100 divisions for 350 volts, but from 80 to 100 divisions the sensitivity was uniform at 10 divisions per volt. In other instruments higher sensitivities have been observed with characteristics indicating that the sensitivity may be made several times that given above. These instruments are, by nature, extremely rugged and simple of construction.

**4. Photoelectric currents in gases between parallel plates as a function of the potential difference.** Norris E. Bradbury. *University of California.*—If one of two parallel plate electrodes in a gas emits photoelectrons, the current received at the collecting electrode is a function

of the potential difference, the gas pressure, the initial velocity of the photoelectrons, and the mobility of the carrier. In the experiments reported here, a quartz mercury arc and a plane zinc electrode were used as the source of photoelectrons. Current-potential difference curves were obtained for different gas pressures in hydrogen and nitrogen, and the ratio of the current, $i$, to the saturation current, $I_0$, obtained in each case. A theoretical equation of J. J. Thomson gives the relation

$$i = [I_0(6\pi)^{1/2}kx]/[c + (6\pi)^{1/2}kx],$$

where $X$ is the field strength, $k$ the mobility of the carrier, and $c$ its random velocity. Adopting the suggestion of Loeb that $c$ is the average velocity of photoelectric emission of the electrons from the plates, the validity of this equation is established by the experimental data which permit the values of the electron mobility $k$ to be determined as a function of $X/p$. Values so obtained agree well with those obtained by Loeb and by Townsend and Bailey. An equation recently given by Langmuir (Phys. Rev. **38,** 1656, (1931)), is shown to be applicable only at low pressures where it yields a satisfactory value of the mean free path of the electron.

**5. On the specific heats of ferromagnetic materials.** PAUL S. EPSTEIN. *California Institute of Technology.*—A theory of ferromagnetism developed by the author leads to the result that, at very low temperatures, the specific heats of ferro-magnetic substances follow the law $c=0.208sR(T/\theta)^{3/2}$, where $R$ is the gas constant and $s$ the number of valency electrons per atom. The constant $\theta$ is closely related to the Curie point $T_0$ being of the order of magnitude of $\frac{1}{4}T_0$. The available experimental data do not go to sufficiently low temperatures to permit a test of this law but they are encouraging as far as the order of magnitude is concerned.

**6. Mobilities of gaseous ions in mixtures of hydrogen and nitromethane and hydrogen and methyl cyanide.** ELIZABETH A. HIGLEY AND CAROLYN C. THORSEN. Introduced by L. B. LOEB. *University of California.*—In continuation of the investigations of L. B. Loeb on ionic mobilities in mixtures of various gases, it seemed worthwhile to investigate the action of nitro-bodies and cyanides. Owing to the toxic and unstable nature of these substances it was decided to study the simplest organic derivatives of the two radicals. The mobilities of the positive and negative ions in Kahlbaum's methyl cyanide were 0.237 cm/sec. and 0.234 cm/sec. respectively, and the values in Kahlbaum's nitromethane were 0.221 cm/sec. and 0.221 cm/sec. respectively. The addition of traces of both of these gases to hydrogen caused an abnormal decrease of the mobility on both ions, and cause a deviation from Blanc's law indicating the formation of a definite addition product with ions of both signs. The effect in nitromethane was distinctly greater than the effect in methyl cyanide. These measurements were made keeping the auxiliary field equal to the driving field, and therefore represent the mobilities on the new standard absolute scale.

**7. Determination of the coefficient of ionization by collision using large plate distances and higher pressures.** FREDERICK H. SANDERS. Introduced by L. B. LOEB. *University of California.*—The coefficient of ionization by collision, $\alpha$, was measured in dry air at a pressure of 380 mm over a range of field strengths varying from $X=13{,}680$ $(X/p=36)$ to $X=7{,}600$ $(X/p=20)$. The ionization chamber used was of such dimensions as to make the investigations possible at plate distances ranging from one to five centimeters. With these large plate distances it was possible to evaulate $\alpha$ for values of $X/p$ as low as 20. It was found that instead of the coefficient being equal to zero at $X/p=30.1$ as shown by Paavola (Archiv für Elektrotechnik **443,** 22 (1929)). $\alpha$ actually has a measurable value at $X/p=20$. Plotting $\alpha/p$ as a function of $X/p$, the curve approaches the zero axis asymptotically. The highest value of $X/p$ attained was 36.5, which is within two percent of the sparking potential at a plate distance of 2.5 centimeters. At this field strength no increase in current with plate distance was noted beyond that given by the simple Townsend relation $i=i_0e^{\alpha d}$. (Laboratory equipment for this research was made possible through a grant-in-aid from the National Research Council.)

**8. The distribution of electrons in the photo-effect by Roentgen rays, classically treated.** JAKOB KUNZ. *University of Illinois. (To be read by title.)*—Several treatments of this effect by means of wave mechanics have been given. If a beam of Roentgen rays passes through a gas, most of the electrons are not given out in the direction of the electric force $E$, but in a more

forward direction. If the direction of observation makes an angle $\theta$ with $c$, the velocity of light, the component of $E$ is $E \sin \theta$ and the intensity of light is $CE^2 \sin^2\theta$ and is proportional to the number of electrons emitted in the direction $\theta$. Moreover, I have shown in a previous article, (Phys. Rev. **6**, 413, (1915)), that in the Roentgen pulse the electric force

$$E_t = \frac{ev \sin \theta}{\delta\rho(c - v \cos \theta)}$$

where the thickness

$$\delta = l(2c - v \cos \theta)/v.$$

The intensity of the beam is again equal to

$$CE_t^2 = \frac{Ce^2v^4 \sin^2 \theta}{\rho^2 l^2}(c - v \cos \theta)^{-2}(2c - v \cos \theta)^{-2}$$

$$= \frac{Ce^2v^4c^2 2}{\rho^2 l^2}\left(1 + \frac{5}{2}\frac{v}{c}\cos \theta\right)\sin^2 \theta$$

a formula deduced in wave mechanics with different constants.

## FRIDAY AFTERNOON 2:00 O'CLOCK

### Joint Meeting with the A.S.P.

### Hall, Room

**9. A theory of the Raman rotation spectra.** WILLIAM V. HOUSTON, *California Institute of Technology*.—The Raman spectrum may be treated as due to variable polarizability, as has been done by Placzek for the vibration lines. If the tensor of polarizability is transformed, by means of the Eulerian angles, to axes which are fixed with reference to the incident beam of light, the periodic change of these angles gives the Raman lines of the rotation spectrum. It is thus possible to evaluate the relative intensities of the lines, as well as their polarization, without any knowledge of the electronic levels of the molecule. This method of treatment explains very nicely why a spherically symmetric molecule, such as methane, shows no rotation spectrum, although it does show a rotation-vibration spectrum.

**10. Secondary effects in the ionization by hard gamma-rays.** E. J. WORKMAN, *National Research Fellow, California Institute of Technology*.—The author has previously reported concerning the increase of the ionization in a metal electroscope, as produced by increasing the wall thickness of the chamber. Another arrangement has been used in which a canalized beam of gamma-rays from the radium, filtered by as much as 3 cm of lead, was directed along the axis of a cylindrical ionization chamber (10 cm long and 9 cm diameter) containing air at atmospheric pressure. Various thicknesses of cellophane, graphite, aluminum, iron, tin, and lead were placed on the front and then on the back of the chamber and the ionization studied. Lead, placed on the back end of the chamber, causes an increase of approximately 60 percent in the ionization when a filter of 3 cm of lead is used. For other materials the increase is nearly proportional to the atomic number. A large part of the increase is doubtless due to ionization by photo electrons from the back wall. Equivalent electron thicknesses of the materials on the front end of the chamber may either increase or decrease the ionization according to whether the material is of low or high atomic number. The order in which the materials arrange themselves with respect to the effect they produce on the ionization, as well as the magnitude of the effect for a given material, depends upon the thickness of the filter.

**11. Absorption bands in the infrared spectrum of Venus.** W. S. ADAMS AND THEODOR DUNHAM, JR. *Mt. Wilson Solar Observatory*.

**12. The absolute magnitudes of the O5 to B2 stars determined from the interstellar lines.** J. A. PEARCE. *Dominion Astrophysical Observatory*.

**13. On the temperatures of Wolf-Rayet stars and novae.** C. S. BEALS. *Dominion Astrophysical Observatory.*

**14. Further details ascribable to bands of the carbon isotope $C_{13}$ in stars of spectral classes R. and N.** R. F. SANFORD. *Mt. Wilson Solar Observatory.*

**15. An Investigation of the hydrocarbon bands in the solar spectrum.** R. S. RICHARDSON. *Mt. Wilson Solar Observatory.*

Papers 11 to 15, inclusive, constitute the contribution of the Astronomical Society of the Pacific to the joint meeting of the Physical Society and the Astronomical Society of the Pacific. The titles of these papers only are included in this program.